Non-Thermal, Atmospheric Plasma: A Means of Water Purification

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Exposure to organic environmental contaminants in water supplies can lead to adverse health effects. Non-thermal plasmas have been proposed for waste-water treatment as a means to degrade organic contaminants without the risks that traditional methods of water purification bring, which include introducing harmful byproducts. In this work, a non-thermal, atmospheric-pressure direct current (DC) plasma was used to degrade methylene blue (MB). This acted as a model system for using plasma to destroy organic contaminants in water. The effects of both air and argon plasmas were observed on MB solutions over various short time intervals. At exposure times above 10 minutes, argon plasma was more effective than air plasma. For both plasmas, longer exposure time led to greater chemical conversion, and the solutions did not recover their color after stirring, implying an irreversible reaction involving MB. To investigate the role of hydroxyl radicals, glycerol and 2- propanol were used as scavengers. Addition of glycerol to solutions after argon plasma treatment resulted in minimal MB recovery whereas addition of 2-propanol induced an approximately 13% recovery. The results suggest that OH radicals are partially responsible for MB degradation. However, there are limitations in measuring OH radical concentrations present or reacted in the solution. More research should be conducted to better understand degradation interactions. This model system furthers our understanding of the role of plasma-induced chemistry in water treatment applications. Elucidating the chemistry responsible for contaminant degradation may lead to the development of alternative systems for water purification using non-thermal, atmospheric plasmas.

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